Section 1:
Pollution Prevention Checklists

Biomedical laboratories can potentially generate a variety of byproducts and recoverable materials in their operations. Some common types may include:

- Spent clearants (xylene)
- Waste formaldehyde
- Waste alcohols
- Mercury fixatives
- Cyanide lysing solutions
- Used chromium reagents
- Waste Acids and Bases
- Metal bearing reagents
- Dyes and Stains
- Obsolete/outdated stock

Introduction to Pollution Prevention

Although it has become a catch phrase, pollution prevention is an integral facility process. Many biomedical laboratories have been practicing pollution prevention for years. Good housekeeping and inventory management, production optimization, recycling, recovery and reuse are all methods of pollution prevention. Pollution prevention takes these ideas and places them under a single heading, but this does not diminish the practices already in use by many biomedical processing facilities.

Pollution prevention involves questioning and reviewing every facility process, the chemicals used and the associated procedures. The ultimate questions that should be asked are: ***'Am I doing this process this way simply because I've always done it this way?'*** and; ***'Is there a better, less polluting and potentially less expensive, way of doing this process?'*** The answers will often be yes.

Pollution prevention consists of waste management approaches that reduce the amount of waste materials generated or requiring disposal. Pollution prevention can reduce the amount of hazardous and non-hazardous wastes generated in your business.

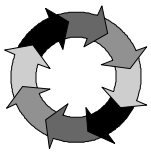
This benefits businesses by minimizing:

- disposal costs
- cost of future liabilities
- transportation costs
- off-site treatment costs
- worker safety costs
- fees and taxes
- insurance costs
- current operating costs (e.g., raw material costs)
- regulatory compliance costs (record keeping, reporting, tracking, lab costs, etc.)

Additionally, pollution prevention can increase business productivity and employee safety, improve environmental protection, and enhance community relations. These benefits may be realized by a business by implementing the following pollution prevention methods:

Source Reduction: is an activity that prevents or reduces the generation of waste materials that may otherwise be released to air, land or water. Examples include: substituting input material or changing production processes to reduce the amount of waste generated. A good example is using mercury free lab chemicals. This eliminates a highly toxic chemical in the facility, reduces environmental liability of disposal, and may reduce waste disposal costs.

Recycling: is the use, reuse, or reclamation of materials. Examples include: employing on-site or off-site techniques to remove contaminants from a waste stream so that the regenerated material can be reused. A good example is distillation of clearants and reuse of the clearant.



To be successful, a pollution prevention program must be organized. It is not hard to organize a pollution prevention program (see Figure 1), but you will need to spend some time to get started. While conducting your self-assessment keep in mind the following principles:

◆ Principles of Pollution Prevention

1. Facility owners/managers must be committed to pollution prevention for it to work.
2. A pollution prevention program should include specific written goals and objectives.
3. Identify your wastes. Are they hazardous or non-hazardous?
4. You should know how your materials and wastes are managed and the associated costs.
5. Train all employees in waste handling and pollution prevention methods.
6. Be aware and follow all waste regulations that apply to your business.
7. Make pollution prevention an integral part of all facility processes, not just a folder on your desk.
8. Identify all the agencies you are working with. Work in cooperation with regulatory agencies. See the regulatory agency as a help and not as a problem.
9. Be prepared to fund pollution prevention programs. You may or may not recoup all costs. Pollution prevention sometimes pays back in non-tangible ways such as improved employee morale.

The following chart shows the basic steps you can use in implementing a pollution prevention program

in your business.

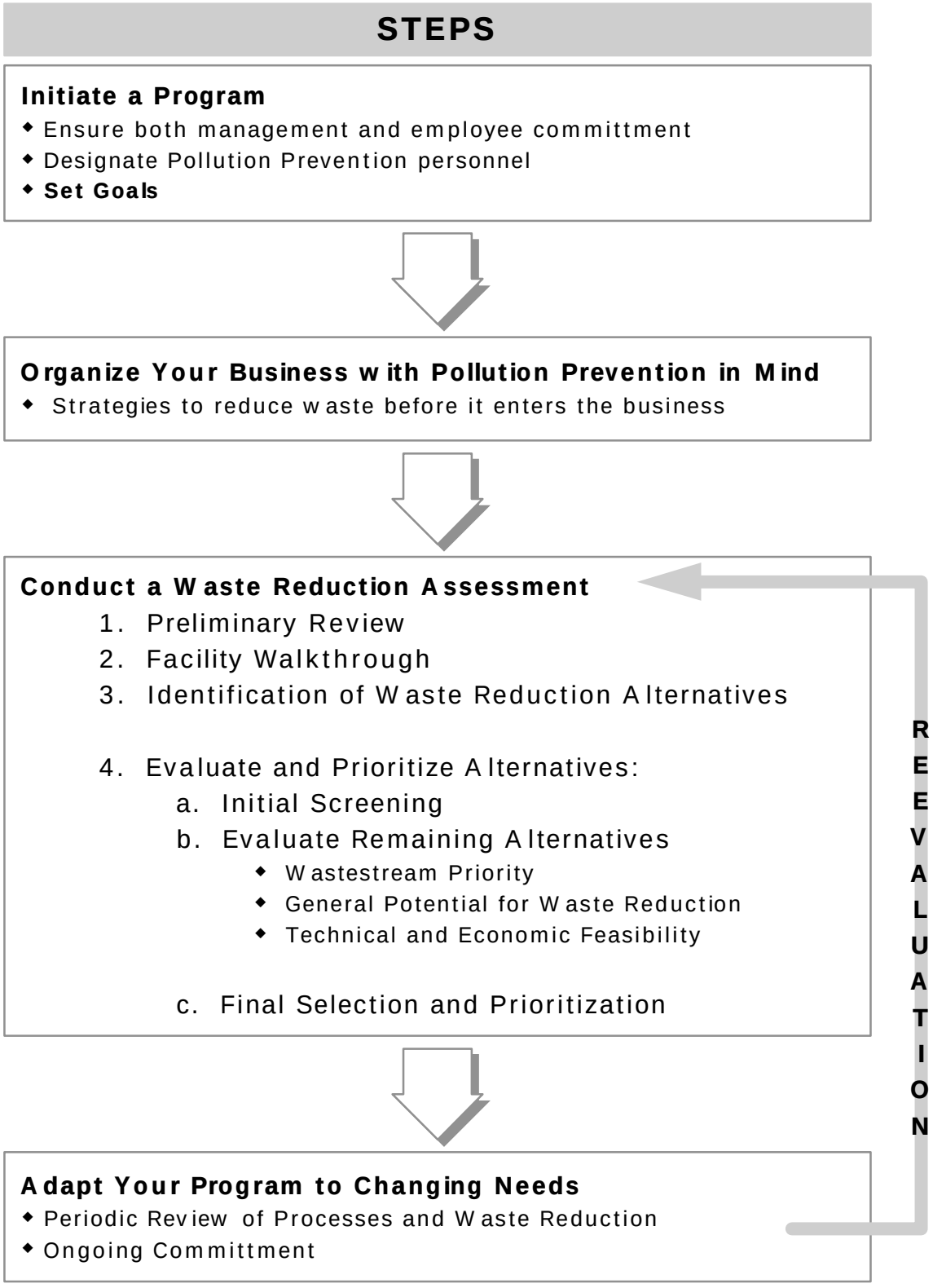


Figure 1. Pollution Prevention Program Steps

Liability

Pollution prevention can be conducted in several areas of a business. These areas pose differing levels of liability. It can be said that the more a business does to reduce the amount of wastes generated the less liability for the business. The more wastes a business sends to disposal the greater the business liability (see Figure 2). The different areas are:

1. **Inventory Management** - buy only what you need to reduce out dated stock chemicals. Rotate stock to use chemicals in date sequence. Check delivered stock for damage to reduce spills and to return damaged stock.

2. **Process Modification** - Modify laboratory processes to reduce waste. Simple changes can significantly reduce the amount of wastes generated.

3. **In-Process Recovery and Reuse** - Increase the amount of materials recovered and reused within the facility process.

4. **On-Site Recovery and Reuse** - Increase the amount of materials recovered and reused within the facility.

5. **Interindustry Exchange** - Unused materials can be exchanged between businesses. One business' unused material may be another's raw material.

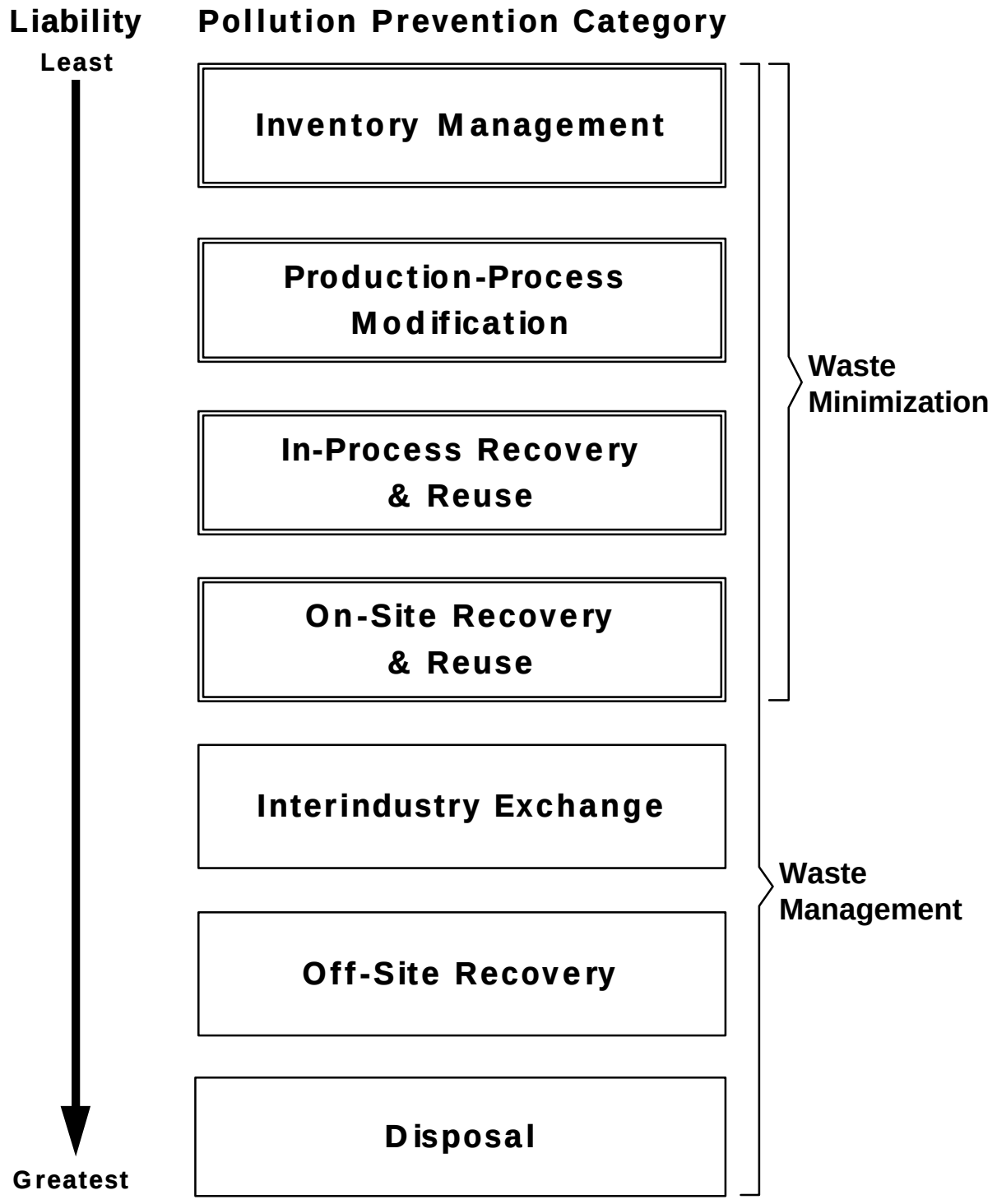
6. **Off-Site Recovery** - Sending materials for off site recycling, reclamation or as a fuel.

7. **Disposal** - Sending materials off-site for disposal as waste. Due to strict regulations hazardous waste disposal carries the greatest level of liability. Disposal is not considered a waste reduction method, but can be an associated process when materials are disposed of properly after waste reduction or recovery techniques have been used.

Note: Treatment is not a method of pollution prevention/waste minimization, but you can treat your hazardous wastes on site if you follow certain regulations. These regulations cover issues of accumulation, storage and labeling requirements, and accident prevention. **See Reference Materials - Managing Hazardous Waste.**

The following chart shows the differing levels of liability by pollution prevention procedure.

Disposal carries the greatest amount of liability.



(Adapted from 'Standard Handbook of Hazardous Waste Treatment and Disposal', McGraw Hill, Harry Freeman, Editor in Chief, 1989)

Figure 2. Levels of Liability

Assessing Your Pollution Prevention Opportunities

These checklists will help you perform a pollution prevention assessment. The objective of this assessment is to identify ways to reduce or eliminate waste, or recover materials, through a careful review of your facility operations and waste streams. After selecting a specific area, or areas, to focus on in your pollution prevention efforts, a number of options should be developed and evaluated. Then, evaluate the technical and economic feasibility of the selected options. Select the most promising pollution prevention options for implementation. Finally, review the operation after implementation to modify as needed.

Useful Questions:

1. What are the recoverable materials and/or hazardous and non-hazardous wastes, and from what processes are the materials/wastes, generated? What are the volumes generated?
2. Which wastes are hazardous and which are not? What makes these wastes hazardous?
3. How much of a particular input material is used in the process?
4. What are the raw material process losses?
5. How efficient is the process?
6. Are unnecessary wastes generated by mixing recyclable wastes with other process wastes, especially with hazardous wastes?
7. What housekeeping practices are used to reduce the amount of waste generated?
8. What process controls are used to improve process efficiency?
9. What are the facility's current hazardous and non-hazardous waste disposal costs (including disposal fees, permit fees, raw material purchases, etc.)
10. **Are you mixing hazardous wastes with non-hazardous wastes? This is extremely important. If you mix hazardous wastes with non-hazardous wastes you are increasing the amount of hazardous waste you pay to have disposed. You should be segregating your hazardous and non-hazardous wastes to reduce you disposal costs. This means that you should also be familiar with you wastes and understand what constitutes a hazardous waste.**

See Appendix D - Hazardous Waste Information, for additional Information.

Checklists

Complete the following pollution prevention checklists to see if your business is maximizing

pollution prevention techniques.

Management Practices

1. Does your facility have an established pollution prevention program in place? **Yes** **No** **Is a specific person or committee assigned to oversee the success of the program?** **Yes** **No** **Does the program have set pollution prevention goals?** **Yes** **No**	If there is enough staff available, a committee may be more successful than a single person. One person is not always available when necessary, could leave the company or otherwise be absent, and may not have the expertise in all necessary areas (See Figure 1). Pollution prevention programs are more successful if they contain written pollution prevention elements, especially when setting goals.
2. Have you characterized your wastes and formalized a strict waste type definition for your facility wastes? **Yes** **No** **Have you implemented a Source Separation Program?** **Yes** **No** **Have you reviewed your product substitution opportunities?** **Yes** **No**	Biomedical laboratories generate a variety of wastes from hazardous, infectious, radioactive to any combination of these. The six main types of wastestreams are: infectious, chemical, radioactive, multihazardous, wastewater, and recyclable wastes. Each waste is categorized at the time of discard into one of your wastestream categories. The waste is placed in the appropriate container for the type of waste it is at the time of discard. This will achieve source separation. This Code of Practice contains information about substituting less hazardous products in laboratory processes. The best place to start is with those processes that generate the most toxic and hazardous wastes.

3. Are there employee education programs on how to avoid excessive waste generation? **Yes** **No** **How often are the training programs offered?**	You can reduce the amount of waste generated by spills if you train employees to properly handle and store hazardous and other wastes. Some trade associations and local environmental health agencies sponsor employee training seminars and some consulting firms offer employee training as part of their package of services. 
4. Are you fully aware of the current local, state, and federal regulations related to hazardous material storage, treatment, disposal, and recycling? **Yes** **No**	Compliance with existing laws and regulations is helpful to a good pollution prevention program. See Reference Manual, Appendix D - Hazardous Waste Information Manual when reviewing waste generation.
5. Has your facility conducted an environmental assessment to determine regulatory compliance? **Yes** **No**	Assistance is available for any concern. See City and State references in Appendix B, or call the City of Albuquerque's Pollution Prevention Program at 873-7004.

Process Management

Production management involves optimizing processes and scheduling to reduce waste generation and dealing with management practices, such as employer/employee relationships, that may have an influence on the amount of waste generated.

1. Are sequential operations adjacent to each other? **Yes** **No**	Sequential operations should be adjacent to avoid excess material handling. This reduces the potential for material and precious metal losses and reduces accidental spills.
2. Are process solutions prepared by trained personnel? **Yes** **No** **Is there a process in place to ensure the minimum volumes of chemicals are used in all processes?** **Yes** **No**	You can often minimize waste and improve the consistency of process solutions by assigning a limited number of properly trained personnel to mix chemicals.
3. Does your facility maintain fume hoods, collectors and fans in proper working condition? **Yes** **No**	Fume collectors and ventilation fans should be maintained in top working condition. Good maintenance practices will reduce health risks and allow better collection of airborne vapors and particulate.
4. Does your facility have a formal facility inspection plan? **Yes** **No**	Regular inspections of your facility's storage, waste treatment, and production areas will help maintain optimal production and identify equipment and process malfunctions early. This will help you identify equipment and process problems early and provide time to correct problems before a small problem becomes a major issue.

Spill Control

Spill control is especially important for biomedical laboratories because of the toxicity of some of the chemicals used in their process solutions.

1. Does your facility conduct equipment inspections on a routine basis to identify leaks or equipment malfunctions? **Yes** **No**	Routine inspections of your lab's process, storage, and waste treatment areas should be conducted on a regular basis to identify leaks and malfunctioning equipment. Identifying problems at an early stage helps reduce spills and other uncontrolled releases.
2. Do you have procedures in place to handle leaks or spills? **Yes** **No**	Fire departments require spill containment, and material segregation of reactive materials, around storage areas to minimize the spread of any spilled material. Ensuring a quick and proper response to leaks and spills can help you reduce waste generated by the cleanup of spills. Keep an emergency spill plan available and educate employees in its use. Training your employees also satisfies legal requirements. See Reference Manual, Appendix E - Hazardous Materials Emergency Response Plan.

◆ Guidelines for a Hazardous Materials Emergency Response Plan

It is required for any business handling materials which are or may be considered hazardous to have a Hazardous Materials Emergency Response Plan (HMERP) in case of spills. If a business is unable to contain a spill and it is discharged into the sanitary sewer or storm drain, released into the air, or spilled on the ground it is very important to notify the proper authorities. By preparing and filing your Hazardous Materials Emergency Response Plan (with the Fire Department, see Appendix E) you will be fulfilling part of the requirements under RCRA (Resource Conservation and Recovery Act - see Appendix D) Hazardous Waste Reporting and under the Superfund Amendments and Reauthorization Act (SARA) community right to know. Following are some general spill control procedures:

1. **Isolate the spill area and limit entry, evacuate area if necessary**
2. **Tend to any injured or contaminated personnel, seek help as necessary**
3. **Notify the proper authorities if needed:**
   During the work week (Mon-Fri, 8AM to 5PM) call the Industrial Waste Engineer at 873-7004. On weekends, holidays, and after hours telephone notification can be made at 873-6217**.**

3. **Equip trained personnel with PROPER personal protective equipment**
4. **Identify the material and quantity spilled and select an appropriate approach (see MSDS or 1994 Emergency Response Guidebook for guidance).**
5. **If the spill is treated on site, dispose of the spill in accordance with federal, state, and local regulations.**

Accidental spills happen fast and without warning so it is also important to have spill control equipment available. Businesses have to determine what spill control method is best for them. Following are some methods/treatments a business can use for spill control including sorbents, treatment agents, or hazardous material vacuums for spills.

Sorbents. Are materials that soak up liquids through absorption or adsorption. Sorbents come in particulate, sock, or pillow form. Depending on the spilled material the sorbents may be considered hazardous after the spill has been cleaned up. Paper is combustible and shouldn't be used on oxidizing agents such as nitric acid.

Treatment Agents. Are usually available for acid, caustic, or solvent spills. They come in dry powder form and are shaken, poured, or sprayed onto a spill. When used properly these agents will neutralize and solidify spills.

Hazardous Material Vacuums. Vacuums can be used to clean up dry chemical spills or to collect and contain virtually any dry pollutants.

Other Equipment. Plastic scoops, brooms, pails, bags, dust pans.

Protective Equipment. Personal protective equipment, warning signs, barricade tape.

General Guidelines for Some Common Spills

All Health and Safety measures should be followed in cleanups using the level of equipment appropriate to the chemical spill. (Excerpt from Prudent Practices in the Laboratory, 1995):

- **Materials of low flammability that are not volatile or that have low toxicity.** This category of hazardous substances includes inorganic acids (e.g., sulfuric and nitric acid) and caustic bases (e.g., sodium and potassium hydroxide). For cleanup, appropriate protective apparel, including gloves, goggles, and (if necessary) shoe coverings should be worn. Absorption of the spilled material with an inert absorbent and appropriate disposal are recommended. The spilled chemicals can be neutralized with materials such as sodium bisulfate (for alkalis) and sodium carbonate or bicarbonate (for acids), absorbed on Floor-Dri® , or vermiculite, scooped up, and disposed of according to the procedures detailed in Chapter 7, section 7.B.8. (*Refers to the book Prudent Practices in the Laboratory, 1995*).

- **Flammable Solvents.** Fast action is crucial when a flammable solvent of relatively low toxicity is spilled. This category includes petroleum ether, pentane, diethyl ether, dimethoxyethane, and tetrahydrofuran. Other workers in the laboratory should be alerted, all flames extinguished, and

any spark-producing equipment turned off. In some cases the power to the laboratory should be shut off with the circuit breaker, but the ventilation system should be kept running. The spilled solvent should be soaked up with spill absorbent or spill pillows as quickly as possible. These should be sealed in containers and disposed of properly. Nonsparking tools should be used in cleanup.

- **Highly Toxic Substances.** The cleanup of highly toxic substances should not be attempted alone. Other personnel should be notified of the spill, and the appropriate safety or industrial hygiene office should be contacted to obtain assistance in evaluating the hazards involved. These professionals will know how to clean up the material and may perform the operation.

- **Dyes.** Please refer to the section in the Reference Manual on Dyes, Stains and Chromogens

Emergency & Notification Phone Numbers

- 911 - Albuquerque Fire Department (Hazmat Emergency Response). Describe spill and material to dispatcher.

- 888-8124 Fire Marshalls Office (Hazmat information)

- 843-2551 Poison Control

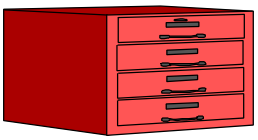
See Appendix B for a complete listing of phone numbers.

❒ Disposal

1. Do you keep track of all the materials you send to disposal? **Yes** **No**	You should maintain and keep on file all manifests, receipts and tracking materials for wastes you have disposed. To reduce the amount of paperwork and business liability you should review your processes and material use to reduce the amount and number of wastes you currently generate. By not generating the waste you will not have to have it disposed.
2. Do you commingle like wastes prior to disposal? **Yes** **No**	Commingling is the process of combining similar wastes into a larger container. For commingling, wastes should not be reactive and should be of the same hazard classification. Compared to lab packs, commingling can be much cheaper (up to 1/4 the cost) than using lab packs. Due to absorbent materials and waste container space Lab packs typically can only accommodate 14 gallons of wastes in a 55 gallon lab pack. Commingling can accommodate the full 55 gallon drum space. (from: "Laboratory Waste Management: A Guidebook," ACS Taskforce on Laboratory Waste Management, ACS, Washington, D.C., 1994) Commingling should be done carefully and employees should be trained in the procedures. Simple errors such as combining incompatible wastes can endanger your business and/or generate a mixed hazardous waste. This can make your wastes difficult to handle and expensive to have disposed. One example is the segregation of non-chlorinated solvents from chlorinated solvents. Mixing a small amount of chlorinated solvent in with the nonchlorinated solvents will cause the entire container to become a hazardous waste and will be expensive to have handled and disposed.
3. Do you segregate wastes prior to disposal? **Yes** **No**	Segregating wastes can greatly reduce the amount of hazardous wastes you generate, thus reducing your disposal costs. If you mix 1 pound of hazardous waste with 9 pounds of nonhazardous waste you will have 10 pounds of a hazardous waste. Your best option is to make sure that the 1 pound of hazardous waste does not get mixed with the nonhazardous wastes.

For more information concerning Hazardous Waste Regulations see Appendix D - Hazardous Waste Information

❒ Purchasing & Inventory Management



1. Do you purchase chemicals in large volumes? **Yes** **No**	When a large container is purchased, often a small quantity is used and the excess is stored. Large volumes increase the possibility of having excess chemicals in the lab that are past their expiration dates. This results in large amounts of potentially hazardous waste. To avoid costly surplus, purchase chemicals in small prepackaged containers. Purchases should be done to fulfill immediate lab needs; this reduces the possibility of excess chemicals and containers.
2. Do you use all the material in a container? **Yes** **No**	Do not begin new procedures with new chemicals, bypassing previously opened containers. Partially filled containers begin to collect around the lab. Unused chemicals can greatly increase the amount of hazardous wastes a lab generates. Locking chemical storage areas and limiting access may help your business reduce chemical use.
3. Do you properly label chemical containers? **Yes** **No**	The cost of having even a small quantity of unknown chemical analyzed prior to disposal can exceed $1,000.00. **Proper labeling:** ◆ Should be legible and permanent. ◆ All appropriate hazard warning labels (i.e. flammable, corrosive, etc.) must be on each container. ◆ The name on the bottle should correspond with the name on the Material Safety Data Sheet. ◆ Decreases the risk of accidents and injuries resulting from improper use or storage. ◆ Allows surplus chemicals to be reused rather than having to dispose of them. ◆ Reduces analysis and associated costs prior to disposal. ◆ Assists in regulatory compliance, such as the hazard communication plan.

4. Do you track your purchases from the time of purchase to final use or disposal? **Yes** **No**	Tracking what the material was used for and how it was disposed of can lead to significant advances in your business' pollution prevention efforts. Tracking a chemical from purchase to disposal can reduce duplicate purchases. Allowing for redistribution of surplus materials can reduce waste generated from partially filled containers or out-of-date stock. Whatever method you use to track purchases (i.e., computer program, ledger books, note cards, etc.) accuracy relies on the cooperation of all lab employees and should be incorporated in your employee training.

Common chemical tracking systems include:

- Bar coding, such as the system approved by the Health Industry Bar Code Council
- System 39 as used by the U.S. Department of Defense
- Chemical Abstract Service (CAS) registry numbers which are universally accepted for identifying specific chemicals and can be used in a chemical tracking system.